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ABSTRACT

Two experiments with 167 first-, third-, and fifth-grade children revealed age-related changes in the composition of natural categories. Categorization was investigated via perceptual similarities of objects and conceptual similarities of superordinate classes. The free-classification paradigm (Garner, 1974) was adapted to natural categories, extending present work on categorization and assessing typicality effects in a complex context. Results indicated that first-graders sorted triads by perceptual similarities among object features; fifth-graders tended to classify by real world superordinate similarity; third-graders mixed both types. All children who received a brief demonstration of potential similarity relations categorized more by conceptual criteria than by simple similarity of features. Significant main effects were found for the variables of grade, instruction, and typicality. It is concluded that the abstract category structure is within the repertoire of younger children, but perceptual similarity may be the compelling basis of early categorization. (Author/RH)

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Development of the Composition of Children's Categories

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Running head: DEVELOPMENT OF CHILDREN'S CATEGORIES

Abstract

Two experiments with 167 first-, third-, and fifth-grade children revealed age-related changes in the composition of natural categories. Categorization was investigated via perceptual similarities of basic level objects and conceptual similarities of superordinate level classes. The free-classification paradigm (Garner, 1974) was adapted to natural categories extending present work on categorization and assessing typicality effects in a complex context.

First-graders sorted triads by perceptual similarities among object features; fifth-graders tended to classify by real world superordinate similarity; third-graders mixed both types. All children randomly assigned to receive a brief demonstration of potential similarity relations categorized more by conceptual criteria than by simple similarity of features. Significant main effects (p 's $< .001$) were found for the variables of grade, instruction and typicality.

It is concluded that the more abstract category structure is within the repertoire of younger children, but perceptual similarity may be the compelling basis of early categorization.

Development of the Composition of Children's Categories

The perceived world is characterized by infinite natural variation, and organisms adapt to this variation by generalizing similarities into conceptual classes. Without this reduction of information into concepts, we would be confronted by an environment of unmanageable and changing detail. It is widely accepted (e.g., Gibson, 1969; Piaget, 1952) that children's thinking about the objects and events of their world begins in relatively concrete terms and develops toward more abstract terms. Studies of the development of childrens' concepts are important monitors of the child's progress toward what Rosch (1978) calls cognitive economy. In the present study both perceptual and conceptual similarities among objects are investigated to reveal their role in the development of the child's natural concepts.

The psychological literature on categories and concepts was recently reviewed by Smith and Medin (1981), who organized it around major theoretical approaches. Well known concept-attainment studies by Bruner, Goodnow and Austin (1956) and Bourne (1966) represent the "classical" approach in which a concept is defined by singly necessary and jointly sufficient attributes. The concepts studied in this approach are experimenter defined and artificial, for example "three green stars with one border".

In contrast is the "natural category" approach developed by Rosch (1973,1975,1978) which concentrates on categories learned and

used in the course of daily living. Trees, fruits and fish as well as furniture,tools and vehicles are all examples of natural categories. The present study accepts the Rosch position in an attempt to explain the changing structures of natural categories as conceived by elementary school children. Following Garner (1974), Rosch maintains that the natural objects of the perceived world are not composed of arbitrary arrangements of attributes; rather they are composed of attributes possessing "correlational structure," with certain combinations of features being frequent while others are rare. "That is, given a knower who perceives the complex attributes of feathers, fur, and wings, it is an empirical fact provided by the perceived world that wings co-occur with feathers more than with fur" (Rosch, 1978, p.29).

Not only do natural categories reflect the structural organization of the world but also they exhibit an internal structure such that some members are central to a category while others are peripheral. A robin is rated a central or typical bird, while a penguin is a peripheral or atypical bird (see Rosch, 1975). Rosch and Mervis (1975) have shown that "family resemblance," indexed by numbers of shared features assigned by subjects, is highly correlated with typicality. A number of variables, e.g., time to learn a new member of a category, are empirically related to rated typicality. In the present experiments it was expected that children's conceptual flexibility would be greater with central than with peripheral category instances.

An important aspect of these investigations is the extent to which conceptual structure is constrained by the structure of the real world and the extent to which perception of world structure is shaped by mediation of the perceptual system. Rosch's work indicates that people are sensitive to bundles of features occurring together regularly. This organismic constraint is specifically pertinent with respect to children's categories. Keil (1981) proposed that structural properties of the environment have orderly effects on cognition as the individual picks up on certain regularities in the world by means of a symbolic "feature correlation detector."

In another day, Gibson and Gibson (1955) argued that ongoing perceptual experience provides more and more differentiated properties of similar things. The Gibsons asked subjects to sort a series of complex stimuli (scribble patterns). All subjects distinguished increasing numbers of dimensions with practice, but older children identified more properties than younger children and adults found more properties than older children. Increasing differentiation of finer levels of perceptual detail might overwhelm us if we did not have the complementary tendency to generalize. Cognitive differentiation and integration have long been accepted as interacting developmental processes (cf. Werner, 1948), but understanding the qualitative changes in conceptual categories still requires empirical elaboration.

Smith and Kemler (1977) have reported evidence for a trend in perceptual development moving from holistic, overall-similarity

relations to dimensional-identity relations. The researchers used the free-classification task developed by Garner (1974), and asked subjects in kindergarten and grades 2 and 5 to classify sets of stimuli varying in size and brightness. For example, a child would be given a triad of objects including a small black square, a small white square, and a slightly larger light gray square. When subjects were instructed to "put together the ones that go together," kindergarteners gave holistic sorts based on overall similarity (i.e. the white and gray squares which are identical in neither size nor brightness, but are highly similar on both). Fifth-graders, in contrast, gave dimensional sorts (e.g., the black and white squares of equal size), grouping objects by identity on a particular property.

The ability to classify objects by dimensional equivalence is a developmental achievement which no doubt reflects an aspect of intelligent functioning (see Kemler, 1982,1983). However, as Smith later pointed out, this may be an achievement confined to particular tasks which are restricted by simple stimulus variation. Indeed Smith (1981) demonstrated that similarity (and not dimensional) relations prevailed in the classifications of children and adults when the complexity of artificial categories was increased. The present study adopts the view of Smith (1981, 1983) who suggests that similarity relations represent the most reasonable way of organizing the complex variation of objects in natural categories. Garner (1978) maintained that stimuli composed of features as well as

dimensions fit better with concepts themselves, but noted that most experiments in classification have not used materials with variable feature sets. The present experiments adapt the free-classification paradigm to natural categories which contain wide featural variation, thus making an important extension of previous work.

It is further suggested here that changes in similarity relations across age are tightly tied to the vertical dimension of category inclusiveness which Rosch, Mervis, Gray, Johnson and Boyes-Braem (1976) identified in a classic series of experiments. Natural category systems are composed of three levels of abstraction: subordinate, basic-level, and superordinate. Superordinate categories (e.g., vehicles; furniture) have relatively few attributes common to all members, while basic-level categories (e.g., cars; chairs) contain objects with bundles of attributes which overlap one another. Categories at the subordinate level have features which largely repeat those at the basic level but contain finer distinctions (e.g., sedans; kitchen chairs). Perceptual similarities of basic-level objects are high in comparison to the similarities of superordinate categories. Superordinate similarity is more conceptual; as a class, animals do not necessarily look or behave alike, but they represent the "same kind of thing" in a more abstract sense.

The following experiments assumed, then, that a nonrandom world provides structure which the child is designed to detect in the form of basic-level categories, and growing with experience is a tendency

to form conventional superordinate classes which are more abstract, but more efficient representations of the real world. The free-classification task was used to reveal age-related differences in sorting materials which permit real world superordinate class membership or imaginary basic-level categorization. Children were sampled from three grade levels with the expectation that Perceptual (basic-level) classifications would characterize the younger subjects, Conceptual (superordinate) classifications would characterize the older group, and the middle group would show either a mixed intermediate stage or a partitioning of subjects into Perceptual or Conceptual solutions. Typicality of the basic-level categories was expected to enhance conceptual processing in all age groups. It was also anticipated that children may be helped to see the more abstract Conceptual solution by means of a simple demonstration of the classification options inherent in the stimulus materials.

Method

Two experiments using the free-classification paradigm assessed age-related differences in the similarity relations comprising natural categories of school children. In this procedure, three pictures are presented and the subject is asked to choose the two that go together best. Experiment 1 contrasted a spontaneous choice condition with a demonstration condition in which the experimenter showed the three ways of choosing two items which could go together. Experiment 2 asked children to think of all the ways two of three

pictures could go together - an instruction intended to be intermediate between the two conditions of the first experiment. Stimulus materials and general procedures were the same for both experiments.

Materials

Stimuli were pictures of objects, hand drawn in full color, mounted on 4 inch x 5 inch (11cm x 13cm) cards, and covered with clear contact paper. There were 36 experimental pictures comprising 12 triads, 3 from each of four superordinate categories (animals, clothing, furniture, vehicles). Six triads depicted exemplars from the most typical thirty percent, and 6 depicted exemplars from the least typical thirty percent of each superordinate category as found in the typicality rating means given by Rosch (1975). In order to contrast perceptual with conceptual similarity, a triad might contain pictures of a natural horse, a horse with webbed feet, and a natural cow. At the perceptual level, a basic-level real horse would be paired with an imaginary horse which shared many visible features. This type of pairing is referred to as a Perceptual Similarity Classification. At the conceptual level, the two pictures sharing more abstract definitional features (horse; cow) go together in that both represent real animals, a superordinate category. This type of pairing is labeled a Conceptual Similarity Classification.

An alternative kind of triad might contain a real cat, a cat with wings, and a dog with a human face. A perceptual classification would group the real cat with the imaginary one. The two animals

with bizarre features would represent the conceptual classification, the superordinate being "imaginary animals." This type of triad was labeled "imaginary" since two of the objects depicted are unreal. The first type of triad was labeled "real" since two of three pictures represent real world objects. Each type of triad also permits a third, relatively arbitrary classification (e.g., real cow & imaginary horse), and this type of solution was labeled Episodic. The experimental variables inherent in the materials, then, were four superordinate categories, two levels of typicality and two kinds of triads. Pictures within triads were colored differently from one another to control for sorting on the basis of color. The aberrant features appeared naturally in the context of the object although they were clearly violations of real world structure. Reproductions of the set of stimuli are found in appendix A. The experimental triads age given in Table 1. Similar picture cards were prepared for practice trials and demonstrations.

Insert Table 1 about here

Experiment 1

Subjects. Forty children from each of grades one, three and five were selected randomly from the consenting populations of two parochial schools in the Denver area. Mean ages were 6 years, 8

months; 8 years, 8 months; and 10 years, 9 months for first-, third- and fifth-graders respectively. One fifth-grader did not finish and could not be replaced in the same school year. School 1 enrolled about 500 children from middle class neighborhoods and provided 68 subjects. School 2 enrolled about 150 children from similar socioeconomic backgrounds and provided 51 subjects. Subjects within grade were assigned randomly to the Spontaneous-choice and Demonstration Conditions. The child who did not finish the testing was from the Demonstration Condition.

Procedures. Children were seen individually in conference rooms in their schools, in random order with respect to experimental condition. Prior to presentation of the experimental triads, three practice triads were given requiring the subject to select human faces, colors and geometric forms which could go together. The experimental triads were randomly ordered for each subject, with the restrictions that not more than four Typical or Atypical triads, nor more than four Real or Imaginary triads appeared consecutively. Each triad was put on the table with the center picture equidistant from the left and right pictures. Left to right order of pictures was random. For all triads, the instructions were, "Put together the two pictures which go together best." Subjects were asked to look at the group carefully before deciding which two went together best, instructions were repeated often as required, but no feedback was given concerning their choices. The few who asked whether a response was right were assured they were doing fine.

Two triads were selected for reclassification after the 12 original classifications had been done. These consisted of the final triad for that child, and the triad last classified by an alternate systematic (Perceptual or Conceptual) solution. The instruction for reclassification was, "Put them together another way," followed by "Which of the two ways is best?" and "Why?"

In the Demonstration Condition, a few subtle but critical differences in procedure were initiated. Three practice triads were: one of the triads used in the Spontaneous-choice Condition, one triad analogous to a Real triad but with different content, and one triad analogous to an Imaginary triad but with different content. The experimenter then said, "Now I'm going to show you two other groups of practice pictures, and I'm going to tell you the ways that they may be put together." The experimenter demonstrated (for example) the Perceptual (overall similarity) classification saying, "It may be done this way, because these two look alike." He demonstrated the Conceptual (structural) classification saying, "Or, it may be done this way, because these two are real things and that one is not real. These two are alike in a different way than the other two are." An analogous set of instructions was used for subjects who saw the Conceptual classification first and the perceptual classification second. Finally, the episodic or arbitrary third pair in the triad was demonstrated with, "Or, it may be done this way. This way is different from the other two ways because they do not look alike, and one of them is real and the other is not." Following the

demonstrations, subjects were reminded that there were three ways of putting the pictures together, and the 12 experimental triads were presented just as in the Spontaneous-choice condition. The same reclassification procedure used with the Spontaneous-choice subjects was carried out at the conclusion of the twelve triads.

Experiment 2

The materials and design were the same as for Experiment 1 except that there was no instructional condition variable.

Subjects. The 48 subjects were from a public school in a middle class suburb of Denver. From the children of consenting parents, 8 boys and 8 girls were randomly selected at each of grades one, three and five.

Procedures. Two changes from procedures of Experiment 1 were implemented. First, the practice set was reduced to one triad from three. Second, and more important, instructions were, "Put together the two pictures which go together best. Think of all the ways that the pictures might go together — think of all the ways that two of them could be alike." The reclassification procedures were identical to those of Experiment 1.

Results

The dependent variable for the major results was the number of Conceptual Similarity Classifications, i.e., the number of choices based on similarity related to real world structure, or the abstract similarity of superordinate-level concepts. There were twelve such

choices possible for scores on the between-subjects variables, i.e., grade level and experimental condition. The statistical significance level adopted for all tests of main effects and interactions was .01. The number of Conceptual Similarity Classifications were submitted to an analysis of variance for a 3 (Grade) by 2 (Condition) by 2 (Typicality) by 2 (type) design with repeated measures on the last two factors. Means and standard deviations for the grade level and experimental condition variables are given in Table 2.

Insert Table 2 about here

Conceptual Similarity Classifications increased with grade level, F (2, 113) = 13.12, $p < .001$. Perceptual similarity decreased correspondingly, as arbitrary pairs accounted for less than five percent of responses at any grade level. All pairwise contrasts were different at less than the .02 level. This effect was consistent across typicality levels and triad type, and there were no statistically significant interactions with grade level. First grade children revealed a strong preference for pairs reflecting perceptual similarity, fifth graders made more conceptual than perceptual similarity decisions, and third graders were divided between those two decision modes. The mean score for third-graders might indicate that individuals were vascilating between the more and less mature

ways of classification, but the data indicate that some individuals were thinking like first-graders while others were thinking like fifth-graders. Twelve of the third-graders scored 0 or 1 and five scored 11 or 12 on the dependent variable. Children of all ages tended to produce highly organized groupings, as episodic classifications were extremely rare. First-graders formed systematic partitions, but these were primarily organized by different similarity relations from the classifications of older subjects.

The Demonstration condition provided only a small amount of instruction beyond that given to the Spontaneous-choice subjects, but the consequent increase in Conceptual similarity choices was substantial, F (1, 113) = 24.05, $p < .001$. The difference appears particularly dramatic at first grade but there were no non-chance interactions with conditions. The demonstration was intended to show that some children may be ready to switch to a more abstract classification mode; the effect was expected but its strength was surprising. The data suggest that children have the superordinate category available and that a brief instruction makes it readily accessible for many subjects.

Within-subjects variables were the typicality of the basic-level concept on which individual triads were constructed (Central or Peripheral), and the type of triad (Real or Imaginary superordinate pair). There were three triads of each kind; Central-Real, Central-Imaginary, Peripheral-Real, and Peripheral-Imaginary. Central triads elicited more Conceptual Similarity Classifications than did

Peripheral triads, F (1, 113) = 15.43, $p < .001$. Real triads brought more conceptual choices than Imaginary triads, F (1, 113) = 13.75, $p < .001$. Figure 1 reveals the overall power of Typical, Real triads to elicit conceptual categorizations across all grade levels. The four superordinate categories manifested in the stimulus items were not different in their effects on classification. The only interaction among variables was a typicality by triad-type interaction, with a greater Central-Peripheral difference for the Real triads.

Insert Figure 1 about here

Reclassifications

At the conclusion of the session, all children were asked to reclassify two of the triads. Only 4 first-graders, 2 third-graders and 1 fifth-grader failed to reclassify at least one of two triads, with the great majority providing alternative solutions for both. Children of all ages were apparently not restricted by the incapacity to produce one or the other systematic classification. Rather, the data imply that even the youngest subjects had access to the more abstract categorization scheme, even when that scheme was not demonstrated for the child (which was the case in the spontaneous condition). Reclassifications were reported as proportions, and the

proportion of Conceptual classifications chosen as "best" over the Perceptual solution, increased across grade for both the Spontaneous and the Demonstration subjects, and all proportions were higher for the Demonstration condition. The increase with grade for Conceptual Similarity choices is parallel to the grade means for the experimental triads. That is, subjects produced alternative solutions when asked to, but they tended to prefer their original classifications as the "best" ones.

The proportions of subjects in the Spontaneous condition who chose the Conceptual classification as the best one when two solutions were given were .23; .53; and .65 for first, third and fifth grade children respectively. The proportions for the Demonstration subjects were .55; .67; and .80 for first-, third- and fifth-graders respectively. These results strengthen the inference, drawn from the initial classifications, that children at every grade level had the ability to make the more abstract classification. The children who favor perceptual similarity apparently have a strong preference for the familiar basic-level category which is directly perceived in visible feature sets. Subjects' responses to the question "Why is this the best way?" often indicated that they understood the different solutions, and they were in the process of making a choice between them. One first-grader concluded: "These are chairs, but these two go (together) because they are both crazy." Fifth-graders articulated the different solutions more often. One subject claimed: "Both ways are good. These look alike, but this way

is better because they are both not right." Finally, one first-grader preferred the Conceptual solution on a Real triad explaining that "Both are like it is."

Experiment 2

Except for the demonstration variable, this experiment replicated Experiment 1 with a different subject pool. Subjects in this experiment were instructed to "Think of all the ways that two of the three pictures could go together." The results of Experiment 2 are of interest since all the patterns in the data, and all effects were parallel to those of the first experiment. Reference to Table 3 indicates that Conceptual Similarity Classifications increased with grade, and all pairwise contrasts among grades were reliably different from one another. Real triads elicited more Conceptual choices than Imaginary triads, and the typicality effect favored Central over Peripheral category members, but did not quite reach statistical significance ($p < .06$). Again the only interaction which reached significance was that of the typicality and type factors. Finally, the reclassification data are important since they replicated the finding that subjects could produce alternate classifications, yet they tended to maintain that their original solutions were the best ones.

Insert Table 3 about here

The results of these experiments were both powerful and reliable. The same patterns and effects were found in two studies with 167 children from three separate subject populations. Further, in the first experiment, the same patterns, including interactions were found in both schools when data were analyzed for the two schools separately. Finally, the grade and condition effects were the same across the four superordinate classes, suggesting some degree of generality from the present results to other natural categories.

General Discussion

The present experiments were designed to investigate perceptual and conceptual relations in children's classifications of natural objects. They extend the current work in classification (e.g., Smith & Kemler, 1977; Smith, 1981) by adapting Garner's (1974) paradigm to stimulus sets with wide feature variation. In agreement with Smith (1981) and Tversky (1977), it was assumed that similarity serves as an organizing principle through which individuals make generalizations, classify objects and form natural concepts. Similarity relations are fundamental to human thinking and they appear to be particularly important in the development of children's concepts. It was anticipated that children's category composition would (a) reflect greater use of conceptual similarity with age, and (b) reflect greater conceptual similarity as a result of a demonstration of classification options. It was further anticipated

that typicality of category members would also aid conceptual processing. The above results strongly support these hypotheses about conceptual development.

The spontaneous classifications of younger children (first-graders) were organized almost exclusively on the basis of perceptual similarities among object features, while the classifications of fifth-graders were organized primarily on the basis of relatively more conceptual similarities among object relations. The older subjects' performance would seem to reveal a relatively more abstract response to real world structure. This is because conceptual similarity choices require the child to group two items which share minimal perceptual attributes, but which share a conceptual relationship to reality which is captured at the superordinate level.

In contrast, the younger subjects tended to ignore imaginary features of the stimuli in order to group items in terms of compelling perceptual likenesses. It appears that the younger children were attempting to form basic-level categories (e.g., two horses, even though one is clearly unreal) which tend to maximize perceptual similarity (see Rosch, 1975). The distribution of reactions among third-graders provides the strong suggestion that the child has two qualitatively distinct modes of seeing similarity in the situations provided, and the child's solutions may switch from one mode to the other rather abruptly. This apparent change-of-stage was facilitated in two ways; by the reclassification task and by the demonstration of options. It is important to note that even the

youngest children (six-year-olds) readily reorganized the materials to form superordinate categories when asked to reclassify two triads. This supports the suggestion by Rosch (1977), that objects are first perceived as members of their basic-level categories, but with additional mental effort may be identified as members of superordinate categories.

The reliable age-related trends in the data indicate that all children produced highly organized classifications, but spontaneous classifications were organized by different similarity relations across age. However, a critical experimental outcome is the finding that all children given a brief demonstration of potential options inherent in the stimuli tended to categorize on the basis of the abstract conceptual relations. This suggests that the more abstract category structure is within the repertoire of the young child, and that minor amounts of instruction can encourage its use. These results provide the further suggestion that the cognitive structures of younger and older children may have more in common than the Piagetian view (e.g., 1970) indicates. Piaget argues that with development arise new structures which are qualitatively distinct from earlier capacities. The present results indicate that younger and older children may have highly similar mental structures, but these capacities become better articulated and more flexible with age.

The present findings concerning category typicality lend some support to the results of Rosch (1973; et al., 1976) and Anglin

(1977) who found that young children learn central category members before peripheral ones. The present results are of interest because the typicality dimension was embedded within a classification context, rather than assessed via the more common rating and reaction time studies. Rosch has consistently found structural typicality to have major consequences in the cognitive processing of categories. The importance of the present results resides in the fact that they support the typicality dimension within a less obvious and more embedded experimental context.

This support is not completely unequivocal, due to the interaction of the typicality and type factors in both experiments. Inspection of Figure 1, however, reveals that conceptual flexibility was most enhanced by typical, real triads. Notice that these triads provide the only situation in which a true, real world superordinate category is possible. The psychological effects of typicality were most pronounced where the materials reflected the empirical facts of real world structure.

The overall pattern of results from the present study raises some further questions about children's conceptual functioning. One issue concerns the ways in which children tend to view object features as combined. One possible conclusion regarding object properties is that younger children organize categories on the basis of perceptual similarity where features of objects are mentally combined as though they were additive and independent (cf. Mervis & Rosch, 1981). Older children may have treated the same features as

non-independent, correlated entities. For these children, perceptual similarity choices may have been largely rejected because, for example, a real cat and a cat with wings are less likely to be seen as "going together" since wings violates the correlational structure within the cat category.

Verbal protocols indicated that younger subjects indeed perceived the conflict aroused by aberrant features, but these features may have been perceived as "added to" other correct features rather than perceived as breaking the correlational structure of the true attributes.

Gibson (1983) has recently argued that more and more embedded relations are detected as the child "searches for order in the world." The present view is that with age and experience, information regarding similarity comes to be organized by more complex relations. Conceptualization of the world changes in that children learn to ignore superficial visual similarity, and the more embedded relationships among objects and events are appreciated. The present findings would indicate some systematic differences across age in the ways that children represent concepts. At the same time the results strongly suggest a certain continuity in the cognitive structures of younger and older children. The stability of the findings give important implications for children's conceptual development as well as for school instruction. A projection of the paradigms of this study to curriculum-relevant concepts should be carried out, as the instructional implications seem practical and compelling.

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Author Notes.

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Table 1

Experimental Picture Triads

Real Triads			
Typical	horse	horse (with webbed feet)	cow
	sweater	sweater (sock arm)	dress
	car	car (6 wheels)	bicycle
Atypical	penguin	penguin (horns)	chicken
	gloves	glove (6 fingers)	boot
	clock	clock (6 hands)	telephone
Imaginary Triads			
Typical	cat	cat (wings)	dog (man's face)
	chair	chair (sink)	bed (stereo pillows
	truck	truck (square wheels)	airplane (feet)
Atypical	hat	hat (sleeve)	watch (vegetables)
	stove	stove (turntables)	refrigerator (books
	wheelbarrow	wheelbarrow (legs)	canoe (pedals)

Table 2

Numbers of Conceptual Similarity Classifications by Grade and Condition

(Maximum is 12)

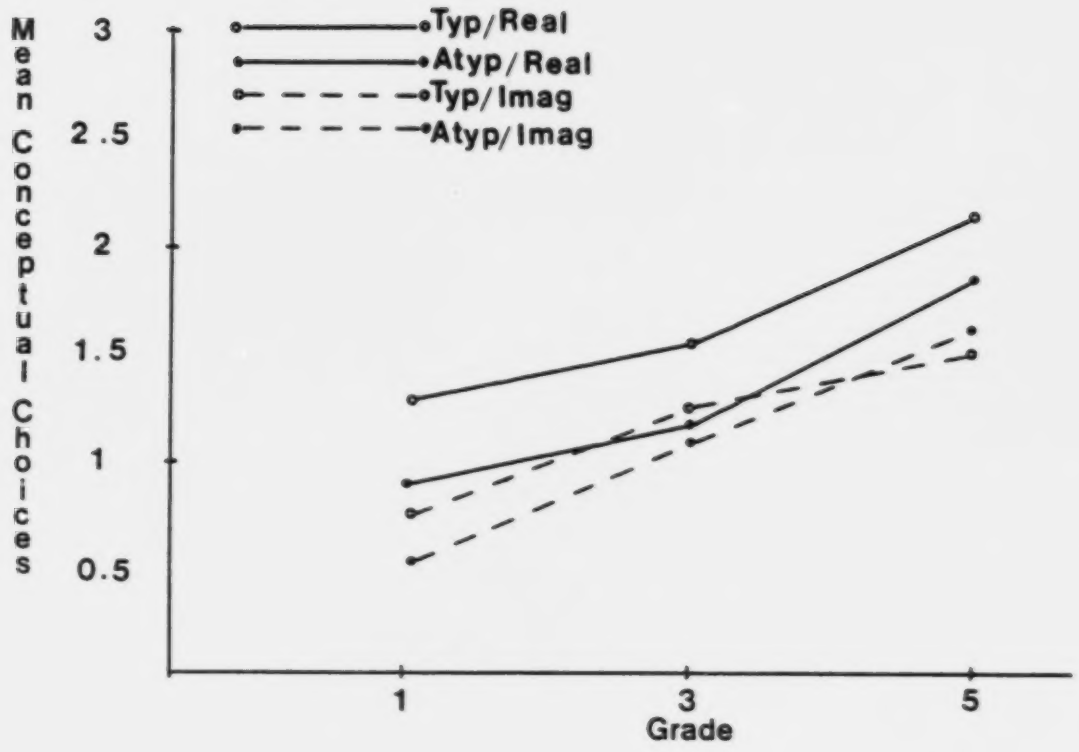
Condition	Grade					
	One		Three		Five	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Spontaneous Choice	1.12	(2.22)	4.04	(4.40)	6.25	(4.69)
Demonstration	6.01	(4.38)	6.54	(5.02)	8.27	(3.79)

Table 3
Mean Number of Conceptual Similarity Classifications by Grade (Experiment 2)

	Grade		
	First	Third	Fifth
Means	2.31	3.94	6.75
Standard Deviations	(2.80)	(4.07)	4.62)

Figure Caption

Figure 1. Conceptual similarity choices by item type and grade level.


Mean Conceptual Choices
3
2.5
2
1.5
1
0.5
Typ/Real
Atyp/Real
Typ/Imag
Atyp/Imag
1
3
5
Grade